

1 WHAT IS CLAIMED IS:

2 1. An invert emulsion drilling fluid comprising

3 an oleaginous/continuous phase

4 a non-oleaginous discontinuous phase

5 a surfactant is a fatty acid ester of diglycerol or triglycerol, and

6 a weighting agent.

7  
8 2. The invert emulsion drilling fluid of claim 1 wherein the surfactant is a di-fatty  
9 acid ester of diglycerol and wherein fatty acid has the formula  $\text{RCO}_2\text{H}$  in which R is an  
10 alkyl or akenyl having 10 to 20 carbon atoms.

11  
12 3. The invert emulsion drilling fluid of claim 1 wherein the surfactant is a di-fatty  
13 acid ester of triglycerol and wherein fatty acid has the formula  $\text{RCO}_2\text{H}$  in which R is an  
14 alkyl or akenyl having 10 to 20 carbon atoms.

15  
16 4. The drilling fluid of claim 1 wherein the oleaginous fluid is selected from diesel  
17 oil, mineral oil, synthetic oil, ester oils, glycerides of fatty acids, aliphatic esters, aliphatic  
18 ethers, aliphatic acetals, or other such hydrocarbons and combinations thereof.

19  
20 5. The drilling fluid of claim 1 wherein the non-oleaginous phase is selected from  
21 fresh water, sea water, brine, aqueous solutions containing water soluble organic salts,  
22 water soluble alcohols or water soluble glycols or combinations thereof.

23  
24 6. The drilling fluid of claim 1 wherein the weighting agent is a water soluble  
25 weighting agent or a water insoluble weighting agent or combinations thereof.

26  
27 7. The drilling fluid of claim 6 wherein the water insoluble weighting agent is  
28 selected from barite, calcite, mullite, gallena, manganese oxides, iron oxides, or  
29 combinations thereof.

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1 8. The drilling fluid of claim 6 wherein the water soluble weighting agent is selected  
2 from water soluble salts of zinc, iron, barium, calcium or combinations thereof.  
3

4 9. The drilling fluid of claim 1 wherein the surfactant is selected from polyglyceryl-2  
5 diisostearate or polyglyceryl-3 diisostearate.  
6

7 10. An invert emulsion drilling fluid comprising  
8 an oleaginous continuous phase  
9 a non-oleaginous discontinuous phase,  
10 a biodegradable surfactant including a di-fatty acid ester of diglycerol and wherein  
11 fatty acid has the formula  $\text{RCO}_2\text{H}$  in which R is an alkyl or akenyl having 10 to 20 carbon  
12 atoms, and  
13 a weighting agent.  
14

15 11. The drilling fluid of claim 10 wherein the surfactant is polyglyceryl-2  
16 diisostearate.  
17

18 12. An invert emulsion drilling fluid comprising  
19 an oleaginous continuous phase  
20 a non-oleaginous discontinuous phase,  
21 a biodegradable surfactant including a di-fatty acid ester of triglycerol and  
22 wherein fatty acid has the formula  $\text{RCO}_2\text{H}$  in which R is an alkyl or akenyl having 10 to  
23 20 carbon atoms, and  
24 a weighting agent.  
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26 13. The drilling fluid of claim 12 wherein the surfactant is polyglyceryl-3  
27 diisostearate.  
28

29 14. A method of formulating an invert emulsion drilling fluid, said method  
30 comprising:

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1 mixing an oleaginous fluid, a non-oleaginous fluid, a biodegradable surfactant and  
2 a weighting agent, wherein the biodegradable surfactant includes a fatty acid ester of  
3 diglycerol or triglycerol in amounts sufficient to form an invert emulsion in which the  
4 oleaginous fluid is the continuous phase and the non-oleaginous fluid is the discontinuous  
5 phase.

6 ~~13~~ 14. The method of claim 13 wherein the a fatty acid ester of diglycerol or triglycerol  
7 is a di-fatty acid ester of diglycerol and wherein fatty acid has the formula  $\text{RCO}_2\text{H}$  in  
8 which R is an alkyl or akenyl having 10 to 20 carbon atoms  
9

10 ~~15~~ 15. The method of claim 13 wherein the a fatty acid ester of diglycerol or triglycerol  
11 is a di-fatty acid ester of triglycerol and wherein fatty acid has the formula  $\text{RCO}_2\text{H}$  in  
12 which R is an alkyl or akenyl having 10 to 20 carbon atoms  
13

14 ~~16~~ 16. The method of claim 13 wherein the oleaginous fluid is selected from diesel oil,  
15 mineral oil, synthetic oil, ester oils, glycerides of fatty acids, aliphatic esters, aliphatic  
16 ethers, aliphatic acetals, or other such hydrocarbons and combinations thereof.  
17

18 ~~17~~ 17. The method of claim 13 wherein the non-oleaginous phase is selected from fresh  
19 water, sea water, brine, aqueous solutions containing water soluble organic salts, water  
20 soluble alcohols or water soluble glycols or combinations thereof.  
21

22 ~~18~~ 18. The method of claim 13 wherein the weighting agent is a water soluble weighting  
23 agent or a water insoluble weighting agent or combinations thereof.  
24

25 ~~19~~ 19. The method of claim 18 wherein the water insoluble weighting agent is selected  
26 from barite, calcite, mullite, gallena, manganese oxides, iron oxides, or combinations  
27 thereof.  
28  
29

1 ~~20.~~ <sup>21</sup> The method of claim 18 wherein the water soluble weighting agent is selected  
2 from water soluble salts of zinc, iron, barium, calcium or combinations thereof.

3 ~~21.~~ <sup>22</sup> A method of drilling a subterranean hole with an invert emulsion drilling fluid,  
4 said method comprising:  
5

6 mixing an oleaginous fluid, a non-oleaginous fluid, a biodegradable surfactant,  
7 and a weighting agent to form an invert emulsion, wherein the biodegradable surfactant  
8 includes a fatty acid ester of diglycerol or triglycerol in amounts sufficient to form an  
9 invert emulsion in which the oleaginous fluid is the continuous phase and the non-  
10 oleaginous fluid is the discontinuous phase, and  
11 drilling said subterranean hole using said invert emulsion as the drilling fluid.

12 ~~22.~~ <sup>23</sup> The method of claim 20 wherein the a fatty acid ester of diglycerol or triglycerol  
13 is a di-fatty acid ester of diglycerol and wherein fatty acid has the formula  $\text{RCO}_2\text{H}$  in  
14 which R is an alkyl or akenyl having 10 to 20 carbon atoms.  
15

16 ~~23.~~ <sup>24</sup> The method of claim 20 wherein the a fatty acid ester of diglycerol or triglycerol  
17 is a di-fatty acid ester of triglycerol and wherein fatty acid has the formula  $\text{RCO}_2\text{H}$  in  
18 which R is an alkyl or akenyl having 10 to 20 carbon atoms.  
19

20 ~~24.~~ <sup>25</sup> The method of claim 20 wherein the oleaginous fluid is selected from diesel oil,  
21 mineral oil, synthetic oil, ester oils, glycerides of fatty acids, aliphatic esters, aliphatic  
22 ethers, aliphatic acetals, or other such hydrocarbons and combinations thereof.  
23

24 ~~25.~~ <sup>26</sup> The method of claim 20 wherein the non-oleaginous phase is selected from fresh  
25 water, sea water, brine, aqueous solutions containing water soluble organic salts, water  
26 soluble alcohols or water soluble glycols or combinations thereof.  
27

28 ~~26.~~ <sup>27</sup> The method of claim 20 wherein the weighting agent is a water soluble weighting  
29 agent or a water insoluble weighting agent or combinations thereof.  
30

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2 <sup>25</sup>~~27~~. The method of claim <sup>27</sup>~~26~~ wherein the water insoluble weighting agent is selected  
3 from barite, calcite, mullite, gallena, manganese oxides, iron oxides, or combinations  
4 thereof.

5 <sup>29</sup>~~28~~. The method of claim <sup>27</sup>~~26~~ wherein the water soluble weighting agent is selected  
6 from water soluble salts of zinc, iron, barium, calcium or combinations thereof.  
7

8 <sup>30</sup>~~29~~. A method of drilling a subterranean well with an invert emulsion drilling fluid,  
9 said method comprising:  
10 mixing an oleaginous fluid, a non-oleaginous fluid, a biodegradable surfactant,  
11 and a weighting agent to form an invert emulsion, wherein the biodegradable surfactant  
12 includes a fatty acid ester of diglycerol, wherein the fatty acid has the formula  $\text{RCO}_2\text{H}$  in  
13 which R is an alkyl or akenyl having 10 to 20 carbon atoms and wherein the  
14 biodegradable surfactant is in amounts sufficient to form an invert emulsion in which the  
15 oleaginous fluid is the continuous phase and the non-oleaginous fluid is the discontinuous  
16 phase,  
17

18 circulating said invert emulsion within said subterranean well and  
19 drilling said subterranean well using said invert emulsion as the drilling fluid.

20 <sup>31</sup>~~30~~. The method of claim <sup>30</sup>~~29~~ wherein the fatty acid ester of diglycerol is a di fatty acid  
21 ester.  
22

23 <sup>32</sup>~~31~~. The method of claim <sup>31</sup>~~30~~ wherein the fatty acid ester of diglycerol is polyglyceryl-  
24 2 diisostearate.  
25

26 <sup>33</sup>~~32~~. A method of drilling a subterranean well with an invert emulsion drilling fluid,  
27 said method comprising:  
28 mixing an oleaginous fluid, a non-oleaginous fluid, a biodegradable surfactant,  
29 and a weighting agent to form an invert emulsion, wherein the biodegradable surfactant  
30

1 includes a fatty acid ester of triglycerol, wherein the fatty acid has the formula  $\text{RCO}_2\text{H}$  in  
2 which R is an alkyl or akenyl having 10 to 20 carbon atoms and wherein the  
3 biodegradable surfactant is in amounts sufficient to form an invert emulsion in which the  
4 oleaginous fluid is the continuous phase and the non-oleaginous fluid is the discontinuous  
5 phase,

6 circulating said invert emulsion within said subterranean well and  
7 drilling said subterranean well using said invert emulsion as the drilling fluid.

8 <sup>34</sup>  
9 <sup>33</sup> The method of claim <sup>33</sup> 32 wherein the fatty acid ester of triglycerol is a di-fatty acid  
10 ester.

11 <sup>35</sup>  
12 <sup>34</sup> The method of claim <sup>33</sup> 32 wherein the fatty acid ester of triglycerol is polyglyceryl-  
13 3 diisostearate.  
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